Brief Project Summary and Project Outcomes

The Indian River Lagoon (IRL) located along Florida's east central coast is under severe stress. The IRL has experienced multiple fish kills, massive brown algal blooms, flourishment of harmful bacteria, and the loss of over 47,000 acres of seagrass. Florida and the IRL community must ensure the best combination of restoration solutions are ultimately implemented to protect the 5 county region's quality of life and the IRL's $7.64 billion dollar impact to the economy.

The Indian River Lagoon, as a bar-built estuary, is far different than the Tampa Bay and Chesapeake Bay systems. They have large, natural watersheds that enhance water circulation whereas the IRL does not. Historically, the IRL did benefit from the natural occurrence of inflows and wetlands before infrastructure was put in place to support a growing population. The goal of Florida Tech's Restore Lagoon Inflow (RLI) research study is to gauge the impacts of the controlled reintroduction of ocean seawater into the IRL as a contributing solution to restoration efforts. The RLI research project is not intended to support an artificial inlet or suggest a complete solution to restoring IRL water quality.

With 2019 - 2020 State of Florida funding of $800,000 administered by the Florida Department of Education, Florida Tech faculty and students are planning and performing studies at lagoon and coastal study sites. An external peer-review panel and outreach efforts are providing calibration support for Florida Tech's RLI project team. The first phase of the RLI study will gather baseline data and modeling on existing water quality, biological parameters and hydrologic conditions at potential locations for future temporary permitted inflow test structures. The RLI Phase 1 Modeling and Engineering Project Research will proceed in parallel with Biological and Water Quality Monitoring in Advance of Enhanced Circulation Pilot.

<u>Modeling and Engineering Project Research Outcomes</u>

Objectives of the modeling and engineering component of the project are aimed at testing the overall hypothesis that controlled water exchanges between the Indian River Lagoon can be engineered to provide improved flushing and water quality within local compartments of the IRL without the negative impacts on littoral sediment budgets linked to permeant stabilized inlets. Specific project outcomes include:

1) Three specific locations will be identified (2 in Banana River and 1 in Indian River County) where exchanges of coastal ocean water into the IRL system can be optimized with respect to practicality, effective water control structures, and eventual permitting;
2) A system of nested hydrodynamic and transport models will be set up that can be operated by accurately exchanging model boundary conditions from the coastal ocean into the IRL estuarine system;
3) The modeling system will be calibrated with respect to historical process data;
4) The potential for improved circulation and flushing of based on controlled ocean inflows to IRL at three selected locations (2 in Banana River and 1 in Indian River County) will be determined;
5) A 20% percent design for water control structures at two locations will be created that can produce the modeled inflows.

Biological and Water Quality Monitoring in Advance of Enhanced Circulation Pilot Outcomes

Ecosystem monitoring is critical to ecosystem health and answers important questions about the effectiveness of programs to maintain ecosystem health." This USGS statement on ecological monitoring is even more relevant when the strategy for maintaining ecosystem health is a dramatic intervention intended to reverse the decline of a degraded system. A large-scale engineering project intended to mitigate poor water quality and improve habitats, such as the proposed enhancement of circulation of the Indian River Lagoon (IRL), requires an accurate understanding of the current status of water quality and biological resources to determine impacts and assess project success. In the IRL system, possible changes or improvements will best be measured by their impacts on water quality (e.g., salinity, temperature and nutrients) and biology (plankton, fishes, seagrasses and benthic fauna). Specific project outcomes include:

1) Predictions of biological responses to restored lagoon inflow based on hydrodynamic model projections of water changes and the environmental tolerances of the organisms
2) An inventory of the phytoplankton, including potentially harmful algal bloom species, that may be impacted, displaced or introduced as a result of restoring lagoon inflow
3) A measure of existing algal bloom activity (cell counts and photosynthetic pigment levels) in the region impacted by restored lagoon inflow
4) An inventory of the benthic fauna that may be impacted, displaced or introduced as a result of restoring lagoon inflow
5) An inventory of seagrasses and drift algae that may be impacted, displaced or introduced as a result of restoring lagoon inflow
6) Quantification of fish larvae recruiting into the IRL, with emphasis on the sites of interest in the current project.
7) Characterization of the environmental determinants of the community structure of fishes in the IRL, with emphasis on the sites of interest in the current project.
8) Formulation of biophysical models to predict the responses of key fish-species to environmental change in the IRL, with emphasis on the sites of interest in the current project.
9) Evaluating alternative indicators of ecological status to reliably assess and monitor anthropogenic disturbance and recovery.
10) Development of cost-effective tools to complement and enhance FWC fisheries resource monitoring with improved detection of historically under sampled species.
11) Calculate impacts of pumping, based on direct dilution by seawater, on concentrations of nutrients in the lagoon; plus, calculate the quantity of nutrients that could be discharged into the coastal ocean.
12) Determine if data from the few existing water quality sensors (~0.5-1.0 m) can be extrapolated to determine conditions in bottom water near proposed pumping locations.
13) Determine how changes to temperature, salinity, and DO that could result from various levels of pumping would influence the geochemical cycling of nitrogen, phosphorus, oxygen plus sulfate and sulfide in the lagoon.

Florida Tech RLI Teams – Principal Investigators

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